DESCRIPTION

EXHAUST MANIFOLD FOR INTERNAL COMBUSTION ENGINE

Technical Field

[0001] The present invention relates to an exhaust manifold for a supercharger-equipped internal combustion engine having multiple cylinders.

Background Art

[0002] There are two sorts of turbocharging systems in an exhaust manifold of an internal combustion engine with a supercharger. One is a pulse turbocharging system and another is a constant-pressure turbocharging system. In the former, it is set up so as to make an exhaust pulse large or enhance in an inlet-port section of a turbine, and the supercharger is driven by the enhanced exhaust pulse. According to the former, its acceleration performance is improved, however, its fuel consumption at a rated horsepower point is increased. In the latter, it is set up so as to change the exhaust pulse into static pressure for using a part with high supercharger effectiveness. According to the latter, its fuel consumption in a rated horsepower point is reduced, however, its acceleration performance is inferior as compared with the former. If both are set up so as to make a main tube's passage small, the exhaust pulse will become enhance, therefore the

acceleration performance will be improved.

[0003] It has been well known that the fuel consumption will be improved when a load application time(build up time) amount is set up for a long time, on the contrary, the fuel consumption will get worse when the load application time amount is set up short. Fig.1 is a graph showing the relation between the load application time corresponding to the diameter of the main tube, and the fuel consumption. In this Fig.1, it turns out that the load application time(load making time) becomes long although the fuel consumption will become good when the diameter of the main tube is greatly set up, on the contrary, the load application time will become short although fuel consumption gets worse when the diameter of the main tube is set up small.

[0004] In the conventional internal combustion engine, the diameter of the main tube is greatly set up provided on the constant pressure system for the purpose of improving the fuel consumption, although the load application time amount became long.

[Patent reference 1] Utility model registration No. 2564126

Disclosure of Invention

[Problem(s) to be solved by the Invention]

[0005] An object of the present invention is to provide

a manifold for an internal combustion engine in which the fuel consumption is improved and the load application time is reduced or shorten.

[Means for Solving the Problem]

[0006] In order to achieve the object mentioned above, in accordance with the invention of claim 1, there is provided an exhaust manifold for a supercharger-equipped internal combustion engine having multiple cylinders, characterized in that;

the diameter D of a main tube of the exhaust manifold and the diameter d of a branch tube of the exhaust manifold satisfy the expression of $1.2 \leq (D/d)^2 \leq 2.5$.

[0007] In accordance with the invention of claim 2, there is provided an exhaust manifold for a supercharger-equipped internal combustion engine having multiple cylinders, characterized in that;

the diameter d of a branch tube of the exhaust manifold and the diameter de of an exhaust valve sheet satisfy the expression of $0.8 \leq (d/de)^2 \leq 1.2$.

[0008] In accordance with the invention of claim 3, there is provided an exhaust manifold for a supercharger-equipped internal combustion engine having multiple cylinders, characterized in that;

the diameter D of a main tube of the exhaust manifold and the diameter D1 of a passage connecting a branch tube to

the main tube satisfy the expression of $0.7 \leq (D/D_1)^2 \leq 1.4$.

[0009] In accordance with the invention of claim 4, there is provided an exhaust manifold for a supercharger-equipped internal combustion engine having multiple cylinders, characterized in that;

a branch tube of the exhaust manifold is smoothly connected to a main tube of the exhaust manifold,

the radius R of the outer peripheral side of a connection connecting the branch tube to the main tube and the radius r of the connection satisfy the expression of $1.7 \leq R/r \leq 2.1$.

[Effect of the Invention]

[00010] According to the invention of claim 1, the load application time (build up time) can be reduced without worsening the fuel consumption. According to the invention of claim 2, 3 and 4, the same effectiveness or advantage as invention of claim 1 can be done so.

[Brief Description of the Drawings]

[00011] Fi.1 is a graph showing the relation between the load application time and the fuel consumption corresponding to the diameter of a main tube.

Fi.2 is a schematic appearance view of the exhaust manifold of the internal combustion engine according to the present invention.

Fi.3 is the schematic diagram of the exhaust manifold showing the figures of the branches connecting the

main tube to the each cylinder.

Fig.4 is the cross-section schematic view showing the connection include angle of the branch tube to the main tube.

Fig.5 is a graph showing the change of the load application time and the fuel consumption relating to the value of (the diameter D of the main tube / the diameter d of the branch tube)^2.

Fig.6 is a graph showing the change of the load application time and the fuel consumption relating to the value of (diameter D of the main tube / diameter de of the exhaust valve sheet de)^2.

Fig.7 is a graph showing the change of the load application time and the fuel consumption relating to the value of (diameter D of the main tube / diameter D_1 of the connection)^2.

Fig.8 is a graph showing the change of the load application time and the fuel consumption relating to the value of (outer periphery radius R / inner circumference radius r)^2.

[Description of Notations]

[00012]

1 Main Tube

2 Branch Tube

4 Piston

5 Exhaust Valve

6 Exhaust Port

7 Connection

10 cylinder

100 Exhaust Manifold

d Diameter of a branch tube

de Diameter of an exhaust valve sheet

D Diameter of a main tube

D1 Diameter of a connection

D2 Diameter of a boa

r Inner circumference radius

R Outer periphery radius

Best Mode for Carrying Out the Invention

[00013] Fi.2 is a schematic appearance view of the exhaust manifold of the internal combustion engine according to the present invention. As for the exhaust manifold 100, one end of a branch tube 2 is connected to a side wall of a main tube 1. Another end of the branch tube 2 is connected to an exhaust port 6 of a cylinder 10. An exhaust valve 5 is arranged in the exhaust port 6 so as to be movable in the direction of the arrow. The exhaust port 6 can be opened and closed with the exhaust valve 5. As shown in Fig.3, a structure of the exhaust manifold 100 is simplified by connecting each cylinder 10a-10f to a main

tube 1 via each branch tube 2.

[00014] As shown in Fig.2, at first, the dimension of the suitable diameter de of an exhaust valve sheet corresponding to the diameter D_2 of a boa, which is equivalent to a diameter of a piston 4, is determined. The diameter d of the branch tube 2 is set up so that its dimension may not change rapidly from the diameter de of the exhaust valve sheet to the diameter D_1 of a connection 7.

[00015] A cross-section configuration of a passage of the branch tube 2 or a connection 7 is not limited in the form of circular. In case the cross-section configuration of the passage of the branch tube 2 or the connection 7 is not formed of circular, it calculates the diameter of the circle of the same area, and applies the value of said calculated diameter as the diameter d of the branch tube 2 and the diameter D_1 of the connection 7, respectively.

[00016] Fig.5 is a graph showing the change of the load application time and the fuel consumption relating to the value of (the diameter D of the main tube / the diameter d of the branch tube)^2. As shown in Fig.5, in the range of 1.2-2.5 of the value of (diameter D of the main tube / diameter d of the branch tube)^2, it turns out that the fuel consumption hardly changes, and the load application time amount is short.

[00017] Basing on the diameter d of the branch tube 2 set up at this time, the diameter D of the main tube 1 is determined using the following expression (1).

$1.2 \leq (D/d)^2 \leq 2.5$ ...... (1)

[00018] As shown in Fig.1, comparing the fuel consumption at the load application time A with the fuel consumption at the load application time B, the fuel consumption at the load application time A is worse than the fuel consumption at the load application time B. However, the difference (a-b) between the fuel consumptions (a) and (b) is very small. Namely, the fuel consumption hardly changes between the time A and the time B. Meanwhile, the load application time A is (B-A) shorter than the load application time B. In consideration the above, it becomes possible that the load application time A is selects so that the difference (a-b) may be settled in the predetermined tolerance range, and then the diameter D of the main tube 1 corresponding to the time A can be derived based on the graph in shown Fig.1. Namely, it becomes possible to determine such value of the diameter D of the main tube 1 that reduces the load application time and prevents the increase in the fuel consumption.

[00019] Fig.6 is a graph showing the change of the load application time and the fuel consumption relating to the value of (diameter D of the main tube / diameter de of the

exhaust valve sheet de)^2. According to Fig.6, it turns out that the fuel consumption hardly changes and the load application time comes short when the value of $(d/de)^2$ exits between 0.8 and 1.2.

[00020] Therefore, the diameter d of the branch tube 2 and the diameter de of the exhaust valve sheet are set up so that the following expression (2) may be satisfied.

$0.8 \leq (d/de)^2 \leq 1.2$ ...... (2)

[00021] Fig.7 is a graph showing the change of the load application time and the fuel consumption relating to the value of (diameter D of the main tube / diameter D_1 of the connection)^2. According to Fig.7, it turns out that the fuel consumption hardly changes and the load application time comes short when the value of (diameter D of the main tube / diameter D_1 of the connection)^2 exits between 0.7 and 1.4.

[00022] Therefore, the diameter D of the main tube 1 and the diameter D1 of the connection 7 are set up so that the following expression (3) may be satisfied.

$0.7 \leq (D/D1)^2 \leq 1.4$ ...... (3)

In the case the cross-section configuration of the passage of the connection 7 is not in the form of circular, the diameter of circle of the same area is applied as the diameter D_1 of the connection 7.

[0023] Fig.8 is a graph showing the change of the load

application time and the fuel consumption relating to the value of (outer periphery radius R / inner circumference radius r)^2. "The outer periphery radius R" and the "inner circumference radius r" which are shown in Fig.8 are concretely shown in Fig.4 which is the cross-section schematic view showing the relation of the connection include angle of the branch tube 2 to the main tube 1 of the exhaust manifold 100.

[0024] According to Fig.8, when the value of (outer periphery radius R / inner circumference radius r) is between 1.7 and 2.1, the fuel consumption hardly changes and the load application time comes short.

Therefore, the value of the outer periphery radius R and the inner circumference radius r are set up so that the following expression (4) may be satisfied.

$1.7 \leq R/r \leq 2.1$ ...... (4)

[0025] Although it is desirable to satisfy the expressions (1) - (4) altogether as for the exhaust manifold 100, if at least one is satisfied, the load application time can be short set up rather than the conventional exhaust manifold, without worsening fuel consumption.